International Journal of Agricultural
Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 9, Issue 4, Aug 2019, 245-252

Original Article

EFFECT OF ORGANIC MANURES AND INORGANIC FERTILIZERS ON YIELD, QUALITY OF SUGARCANE AND SOIL HEALTH IN THE LONG TERM MANURIAL EXPERIMENT

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ABSTRACT

Imbalance in the use of organic manures and fertilizers has lead to deleterious effect on soil productivity, yield and quality of sugarcane. A permanent manurial experiment was carried out at Sugarcane Research Station, Cuddalore, Tamil Nadu to evaluate the long term effect of manures and fertilizers on yield and quality of sugarcane in the north eastern region of Tamil Nadu. The 21st plant crop of CoC 671 was evaluated in the permanent manurial experiment with eight main and six sub plot treatments replicated twice in a split plot design. The results of the statistical analysis of cane yield revealed that 21st plant crop of CoC 671 was significantly increased to 84.30 t ha^{-1} due to the soil application of nitrogen @ 350 kg ha^{-1}+ as neem cake blended urea in combination with recommended dose of P &K and compost. The CCS per cent was also significantly increased due to the various levels of nitrogen in combination with recommended dose of P, K and compost. The evaluation of soil pH and EC as influenced by long term application of various levels of nitrogen in combination with P, K and compost did not vary widely. The available nitrogen status of the soil was significantly increased due to the soil application of various levels of nitrogen in combination with P, K and compost. The organic carbon content of the soil as influenced by the soil application of P, K and compost as well as various levels of nitrogen was found to be significant.

KEYWORDS: Sugarcane, Imbalance-Permanent Manurial Experiment, Compost, Neem Cake & Available Nitrogen

Received: May 07, 2019; **Accepted:** May 27, 2019; **Published:** Jul 09, 2019; **Paper Id.:** IJASRAPR201931

INTRODUCTION

Sugarcane crop sustains the second largest organized agro industry. This has enabled us to be the largest producer of sugar and second largest producer of sugarcane in the world. The different components of integrated nutrient management in sugarcane are in combination with inorganic fertilizers include intercropping with legume, application of organic manures and bio fertilizers. Sugarcane is an exhaustive crop which depletes the native plant nutrients status of the soil due to the high removal of nutrients required for growth and development (Snehal Joshi and Pawer, 2005). The soils of north eastern regions of Tamil Nadu which are under intense sugarcane cultivation from time immemorial were subjected to decline in soil fertility due to the inadequate supply of organic manures and over dependence of chemical fertilizers. As a result of the imbalance in the use of organic manures and fertilizer nutrients have lead to deleterious effect on soil productivity, yield and quality of sugarcane (Perumal, 1995).

Sugarcane is the major crop cultivated to the extent of 3.04 lakhs hectares in Tamil Nadu and 1.08 lakhs

hectares in North Eastern region. Balanced application of fertilizer nutrients in combination with organic manures paved the way for sustaining higher yield and quality of sugarcane besides improving the fertility status of the soil.

The main aim of the permanent manorial experiment is to monitor the cumulative effect of adding organic manure and inorganic fertilizers on the yield and quality of sugarcane and also to evaluate the changes in physicochemical properties of soil. The permanent manurial experiment on sugarcane at Sugarcane Research Station, Cuddalore is in operation from 1963-64 onwards. In this paper 21st plant crop's result is presented.

MATERIALS AND METHODS

The 21st plant crop of sugarcane CoC 671 was tested in the permanent manurial- experiment in a split plot design with eight main plots and six sub plot treatments replicated twice in a sandy clay loam soil at Sugarcane Research Station, Cuddalore during 2009-2010.

Treatments

Main Plot Treatments

M_1	-	C0	P0	K 0
M_2	-	C0	P0	K 115
M_3	-	C0	P 65	K 0
M_4	-	C0	P 65	K 115
M_5	-	C 25	P0	K 0
M_6	-	C 25	P0	K 115
M_7	-	C 25	P 65	K 0
M_8	-	C 25	P 65	K 115

Sub Plot Treatments

S_1	-	210 kg N ha^{-1} as urea
S_2	-	210 kg N ha^{-1} as urea + neem cake
S_3	-	280 kg N ha^{-1} as urea
S_4	-	280 kg N ha^{-1} as urea + neem cake
S_5	-	350 kg N ha^{-1} as urea
S_6	-	350 kg N ha^{-1} as urea + neem cake

(Urea + neem cake at the ratio of 4:1)

C	-	Compost @ 25 t ha^{-1}
P	-	P_2O_5 @ 65 kg ha^{-1}
K	-	K_2O @ 115 kg ha^{-1}

The main plot treatments consist of different combinations of recommended levels of phosphorus, potassium and compost each @ 63.5 and 115 kg ha^{-1} and 25 t ha^{-1} respectively. The sub plot treatments consist of various levels of nitrogen @ 210, 280 and 350 kg ha^{-1} in the form of prilled urea and neem cake blended urea. The nitrogen and potassium were applied in three equal splits on 30, 60, 90th day after planting and phosphorus and compost were applied as basal dose. The effect of various levels of nitrogen and its interaction with P, K and organic manures on yield and quality of sugarcane were evaluated. Five numbers of sugarcane samples at harvest were collected at random from each treatment plots and the juice was extracted and analyzed for various quality parameters by Meade and Chen (1977) method. The effect of organic manures and fertilizer nutrients on quality of juice was evaluated.

RESULTS AND DISCUSSIONS

Cane Yield

The 21st crop of CoC 671 was planted at Sugarcane Research Station, Cuddalore. The increase in levels of N both with and without blended neem cake significantly increased cane yield (Table 1) and the highest cane yield (84.30 t ha^{-1}) was recorded in the plot received 350 kg N ha^{-1} as NCBU and compost, P and K. Among the various subplot treatments involving graded levels nitrogen, application of N @ 350 kg ha^{-1} in the form of neem cake blended urea recorded the highest yield of 81.64 t ha^{-1} and was found to be significantly superior to the rest of the treatments, whereas the lowest yield was recorded in the treatment that received N @ 210 kg ha^{-1} in the form of prilled urea (73.89 t ha^{-1}). The results also revealed that with increase in levels of nitrogen ranging from 210 to 350 kg ha^{-1}, the sugarcane yield also found to increase from 73.89 to 81.64 t ha^{-1}. Yadav (1980) and Achuthan *et al*., (1989) also reported that the yield of sugarcane mainly depends on tiller population, which is linearly related to the increase in levels of nitrogen application and ultimately increase the yield of cane. The interaction of nitrogen with P, K and organic manures on sugarcane yield was found to be significant and the cane yield ranged from 68.98 to 84.30 t ha^{-1}, the highest yield was recorded in the treatment that received N @ 350 kg ha^{-1} as neem cake blended urea in combination with recommended dose of P, K and compost which was found to be significantly superior to the rest of the treatments, whereas the lowest yield was recorded in the treatment that received N @ 210 kg ha^{-1} as prilled urea alone. Chithra (1992) also reported the similar results while evaluating the influence of neem cake blended urea on the yield of sugarcane. The increase in yield of sugarcane might be attributed due to the balanced fertilization of sugarcane with fertilizer nutrients and organic manures besides the use of urea coated with neem cake as a source of slow release nitrogenous fertilizers.

Commercial Cane Sugar

The results of the statistical analysis of CCS per cent (Table 2) increased significantly due to the graded levels of nitrogen in combination with P, K and compost and the value ranged from 11.00 to 13.58 per cent respectively. The higher values of CCS per cent (13.58) were recorded in the treatments that received N @ 350 kg ha^{-1} in the form of neem cake blended urea in combination with recommended dose of P, K and compost, whereas the lowest values were recorded in N @ 210 kg ha^{-1} as prilled urea alone. Chithra (1992) also reported similar results while evaluating the influence of graded levels of nitrogen in combination with P, K and organic manures on juice quality parameters of sugarcane.

Soil Fertility Status

The EC of soil (Table 3) increased with increase in levels of N. The pH of soil (Table 4) significantly decreased to 7.54, 7.56, 7.61 and 7.67 in plots received the compost. The organic carbon content of soil was higher in the plots received

the compost than the plots without the compost (Table 5). The available N content increased with increase in levels of N. The available N was highest in the treatments having the N at 350 kg ha^{-1} with or without neem cake (232 and 240 kg ha^{-1}) respectively. The available N content was higher in plots received the compost than the plots without compost (241 kg ha^{-1}) (Table 6). The available P content (Table 7) significantly influenced by the N levels as well as the addition compost, P and K. The available P was higher in the plots recorded with P than other treatments. The available K was recorded highest i. e. 268 kg ha^{-1} in the treatment received with compost, P and K. The addition of K increased the available K content in soil (Table 8).

CONCLUSIONS

The 21st plant crop of sugarcane CoC 671 was tested in the permanent manurial experiment in a split plot design with eight main plots and six sub plot treatments replicated twice in a sandy clay loam soil at Sugarcane Research Station, Cuddalore. The highest yield was recorded in the treatment that received N @ 350 kg ha^{-1} as neem cake blended urea in combination with recommended dose of P, K and compost which was found to be significantly superior to the rest of the treatments. The higher values of CCS per cent (13.58) were recorded in the treatments that received N @ 350 kg ah^{-1} in the form of neem cake blended urea in combination with recommended dose of P, K and compost. Organic carbon content of soil was higher in the plots received the compost than the plots without the compost. The available N was highest in the treatments having the N was highest in the treatments having the N at 350 kg ha^{-1} with or without neem cake. The available P was higher in the plots recorded with P than other treatments. The available K was recorded highest i. e. 268 kg ha^{-1} in the treatment received with compost, P and K. The addition of K increased the available K content in soil.

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TABLES

Table 1: Sugarcane Yield of 21st Plant Crop as Influenced by Organic Manure and Fertilizer (Mean of two Replications)

Main Plot Sub Plot N Levels (kg/ha)	M1 (Control)	M2 (K alone)	M3 (P alone)	M4 (P &K)	M5 (Compost)	M6 C & K)	M7 (C & P)	MS (C, P & K)	Mean
S1- 210 kg as Urea	68.98	72.87	73.30	73.91	73.79	75.26	76.03	76.94	73.89
S2 - 210 kg as NCBU	69.62	73.29	73.84	74.55	74.27	74.95	76.50	77.91	74.36
S3 - 280 kg as Urea	74.23	74.91	75.01	75.34	76.09	76.47	77.87	79.16	76.14
S4 - 280 kg as NCBU	74.44	75.40	75.43	75.87	76.65	77.25	78.59	80.40	76.82
S5 - 350 as Urea	78.11	79.74	80.25	80.96	80.29	81.30	81.91	83.09	80.71
S6 - 350 kg as NCBU	79.24	80.47	80.91	81.63	81.66	82.56	82.35	84.30	81.64
Mean	**74.10**	**76.11**	**76.46**	**77.04**	**77.13**	**77.96**	**78.88**	**80.39**	

	SED	CD (P=0.05)
Main plot (M)	0.083	0.195
Sub plot (S)	0.085	0.171
M x S	0.233	0.482
S x M	0.239	0.483

Table 2: CCS % of Sugarcane 21st Plant Crop as Influenced by Organic Manure and Fertilizer (Mean of Two Replications)

Main Plot Sub Plot N Levels (Kg/Ha)	M1 (Control)	M2 (K alone)	M3 (P alone)	M4 (P &K)	M5 (Compost)	M6 C & K)	M7 (C & P)	MS (C, P & K)	Mean
S1- 210 kg as Urea	11.00	11.05	12.07	12.21	12.27	12.20	13.20	13.42	12.17
S2 - 210 kg as NCBU	11.04	11.04	12.12	12.18	12.20	12.52	13.35	13.47	12.24
S3 - 280 kg as Urea	11.02	11.07	12.15	12.20	12.27	12.50	13.42	13.52	12.26
S4 - 280 kg as NCBU	11.05	11.05	12.17	12.18	12.25	12.50	13.40	13.54	12.26
S5 - 350 as Urea	11.04	12.12	12.18	12.00	12.20	12.70	13.45	13.54	12.40
S6 - 350 kg as NCBU	11.05	12.07	12.18	12.25	12.30	12.72	13.50	13.58	12.45
Mean	**11.03**	**11.40**	**12.14**	**12.17**	**12.24**	**12.52**	**13.38**	**13.51**	**12.30**

	SED	CD (P=0.05)
Main plot (M)	0.062	0.148
Sub plot (S)	0.045	0.091
M x S	0.132	0.277
S x M	0.127	0.258

Table 3: EC (dSm^{-1}) of Post Harvest Soils in 21st Plant Crop as Influenced by Organic Manure and Fertilizer (Mean of Two Replications)

Main Plot Sub Plot N Levels (kg/ha)	M1 (Control)	M2 (K alone)	M3 (P alone)	M4 (P &K)	M5 (Compost)	M6 (C & K)	M7 (C & P)	MS (C, P & K)	Mean
S1- 210 kg as Urea	0.21	0.23	0.24	0.23	0.24	0.21	0.21	0.23	0.23
S2 - 210 kg as NCBU	0.23	0.22	0.26	0.22	0.21	0.22	0.23	0.24	0.23
S3 - 280 kg as Urea	0.24	0.25	0.27	0.25	0.23	0.24	0.25	0.25	0.25
S4 - 280 kg as NCBU	0.25	0.25	0.29	0.28	0.27	0.26	0.28	0.28	0.27
S5 - 350 as Urea	0.24	0.25	0.28	0.27	0.25	0.25	0.28	0.25	0.26
S6 - 350 kg as NCBU	0.26	0.26	0.27	0.29	0.27	0.27	0.25	0.28	0.27
Mean	**0.24**	**0.24**	**0.27**	**0.26**	**0.25**	**0.24**	**0.25**	**0.26**	

	SED	CD (P=0.05)
Main plot (M)	0.005	0.011
Sub plot (S)	0.005	0.010
M x S	0.013	NS
S x M	0.014	NS

Table 4: pH of Post Harvest Soils in 21st Plant Crop as Influenced by Organic Manure and Fertilizer (Mean of Two Replications)

Main Plot Sub Plot N Levels (kg/ha)	M1 (Control)	M2 (K alone)	M3 (P alone)	M4 (P &K)	M5 (Compost)	M6 (C & K)	M7 (C & P)	MS (C, P & K)	Mean
S1- 210 kg as Urea	7.43	7.68	7.78	7.70	7.55	7.63	7.63	7.68	7.63
S2 - 210 kg as NCBU	7.80	7.75	7.70	7.75	7.58	7.55	7.63	7.60	7.67
S3 - 280 kg as Urea	7.83	7.83	7.75	7.78	7.55	7.53	7.58	7.58	7.68
S4 - 280 kg as NCBU	7.78	7.80	7.80	7.70	7.50	7.55	7.63	7.68	7.68
S5 - 350 as Urea	7.83	7.75	7.68	7.63	7.53	7.48	7.60	7.80	7.66
S6 - 350 kg as NCBU	7.85	7.73	7.65	7.60	7.55	7.63	7.60	7.68	7.66
Mean	**7.85**	**7.75**	**7.73**	**7.69**	**7.54**	**7.56**	**7.61**	**7.67**	

	SED	CD (P=0.05)
Main plot (M)	0.03	0.07
Sub plot (S)	0.02	0.02
M x S	0.07	NS
S x M	0.07	NS

Table 5: Organic Carbon (%) of Post Harvest Soils in 21st Plant Crop as Influenced by Organic Manure and Fertilizer (Mean of Two Replications)

Main Plot Sub Plot N Levels (kg/ha)	M1 (Control)	M2 (K alone)	M3 (P alone)	M4 (P &K)	M5 (Compost)	M6 (C & K)	M7 (C & P)	MS (C, P & K)	Mean
S1- 210 kg as Urea	0.39	0.40	0.41	0.45	0.53	0.53	0.55	0.56	0.48
S2 - 210 kg as NCBU	0.38	0.41	0.43	0.46	0.55	0.54	0.56	0.57	0.49
S3 - 280 kg as Urea	0.41	0.41	0.42	0.46	0.56	0.55	0.54	0.58	0.49
S4 - 280 kg as NCBU	0.39	0.43	0.44	0.46	0.58	0.53	0.57	0.56	0.50
S5 - 350 as Urea	0.41	0.45	0.43	0.43	0.59	0.60	0.58	0.63	0.52
S6 - 350 kg as NCBU	0.41	0.40	0.45	0.44	0.61	0.57	0.60	0.59	0.51
Mean	**0.40**	**0.42**	**0.43**	**0.45**	**0.57**	**0.55**	**0.57**	**0.58**	

	SED	CD (P=0.05)
Main plot (M)	0.01	0.02
Sub plot (S)	0.01	0.02
M x S	0.02	NS
S x M	0.02	NS

Table 6: Available N (kg/ha) of Post Harvest Soils in 21st Plant Crop as Influenced by Organic Manure and Fertilizer (Mean of Two Replications)

Main Plot Sub Plot N Levels (kg/ha)	M1 (Control)	M2 (K alone)	M3 (P alone)	M4 (P &K)	M5 (Compost)	M6 (C & K)	M7 (C & P)	MS (C, P & K)	Mean
S1- 210 kg as Urea	179	176	171	176	203	198	200	214	189
S2 - 210 kg as NCBU	188	189	174	202	206	208	209	223	203
S3 - 280 kg as Urea	204	207	200	203	221	222	219	239	214
S4 - 280 kg as NCBU	210	211	212	208	213	213	217	250	217
S5 - 350 as Urea	219	222	221	218	237	240	244	257	232
S6 - 350 kg as NCBU	223	222	229	229	246	252	257	265	240
Mean	**204**	**205**	**202**	**201**	**221**	**222**	**224**	**241**	

	SED	CD (P=0.05)
Main plot (M)	4.7	11.1
Sub plot (S)	4.2	8.5
M x S	11.8	NS
S x M	11.9	NS

Table 7: Available P (kg/ha) of Post Harvest Soils in 21st Plant Crop as Influenced by Organic Manure and Fertilizer (Mean of Two Replications)

Main Plot Sub Plot N Levels (kg/ha)	M1 (Control)	M2 (K alone)	M3 (P alone)	M4 (P & K)	M5 (Compost)	M6 (C & K)	M7 (C & P)	MS (C, P & K)	Mean
S1- 210 kg as Urea	8.84	8.50	10.88	11.23	11.47	11.66	13.85	14.96	11.42
S2 - 210 kg as NCBU	8.75	8.80	11.88	12.00	10.88	10.75	14.81	15.34	11.65
S3 - 280 kg as Urea	9.19	9.96	11.75	12.38	11.25	11.63	15.30	16.38	12.23
S4 - 280 kg as NCBU	9.37	9.66	12.88	13.25	11.75	12.38	15.43	16.25	12.68
S5 - 350 as Urea	9.37	9.68	13.83	14.88	11.50	12.75	16.88	18.40	13.36
S6 - 350 kg as NCBU	9.39	9.85	14.00	15.75	12.63	14.13	17.00	19.43	14.02
Mean	**9.15**	**9.41**	**12.53**	**13.25**	**11.58**	**12.21**	**15.54**		

	SED	CD (P=0.05)
Main plot (M)	0.17	0.39
Sub plot (S)	0.18	0.36
M x S	0.49	1.01
S x M	0.50	1.02

Table 8: Available K (kg/ha) of Post Harvest Soils in 21st Plant Crop as Influenced by Organic Manure and Fertilizer (Mean of Two Replications)

Main plot sub plot N levels (kg/ha)	M1 (Control)	M2 (K alone)	M3 (P alone)	M4 (P &K)	M5 (compost)	M6 (C & K)	M7 (C & P)	MS (C, P & K)	Mean
S1- 210 kg as Urea	158	251	200	260	215	259	212	277	229
S2 - 210 kg as NCBU	169	258	213	255	223	251	222	265	232
S3 - 280 kg as Urea	145	241	222	209	212	230	275	266	218
S4 - 280 kg as NCBU	144	239	225	210	217	236	217	261	219
S5 - 350 as Urea	134	234	226	214	210	219	223	266	216
S6 - 350 kg as NCBU	143	233	222	216	214	227	227	273	219
Mean	**149**	**243**	**218**	**227**	**215**	**237**	**219**	**268**	

	SED	CD (P=0.05)
Main plot (M)	0.73	1.58
Sub plot (S)	0.08	0.15
M x S	0.76	1.62
S x M	0.22	0.43